Chapter 1
Introduction

1-1. Purpose

This engineer manual (EM) contains planning and management guidelines to be used for the cleanup and environmental restoration of sites contaminated by radioactive waste containing low-level radioactive waste (LLRW) either alone or combined with hazardous/toxic components to make mixed waste (MW). Specifically, the guidelines relate to remedial action concerning essentially uncontrolled LLRW or MW contamination arising from past practices at the sites. The primary purpose of this manual is to describe the regulatory and management responsibility related to U.S. Army Corps of Engineers (USACE) activities at LLRW and MW sites. This manual is not intended to provide detailed technical recommendations or sophisticated scientific procedures. The manual will necessarily incorporate some technical information in order to provide background for the regulatory and management responsibilities. In addition to USACE, the Army, and the Department of Defense (DoD), these responsibilities are defined/enforced by other federal agencies including the Nuclear Regulatory Commission (NRC), the Department of Energy (DOE), the Environmental Protection Agency (EPA), the Department of Transportation (DOT), and the Occupational Safety and Health Administration (OSHA).

1-2. Applicability

The guidelines within this manual are applicable to all USACE elements and major subordinate commands having responsibility through governmental interagency agreement or by assignment from Headquarters, USACE (HQUSACE) for the remediation of sites contaminated by LLRW and MW. These guidelines are applicable to accomplishment of both the Military and Civil Works missions of USACE. Strictly chemical or biological aspects of sites are not addressed except in passing reference to their component part of mixed waste. Involvement may arise, for example, as support to site-owning agencies such as the DOE or as support to the EPA activities associated with non-government-owned site remediation. Such site remediation activities will fall within the purview of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Resource Conservation and Recovery Act (RCRA); the Hazardous and Solid Waste Amendments (to RCRA); or the Superfund Amendments and Reauthorization (of CERCLA) Act (SARA). In the event of military (Department of the Army, specifically) responsibility for MW and LLRW sites requiring remediation, this manual applies as directed by HQUSACE. Such involvement will fall under the Defense Environmental Restoration Program (DERP). Headquarters, U.S. Army Industrial Operations Command (IOC), Rock Island, IL, is responsible for managing the Department of Army and Defense LLRW disposal programs. In such a role, IOC is also responsible for maintaining the related required records on the type and quantity of disposed LLRW.

1-3. References

Related technical references are listed in Appendix A. References to regulations are listed in Appendix C.

1-4. Appendices

Appendix A is the alphabetical listing of references cited in this manual. Appendix B presents a glossary of terms and abbreviations. Acronyms are defined in Appendix B. Appendix C is a bibliography of regulatory documents generally applicable to the regulations and laws pertaining either to LLRW or to hazardous, toxic, and radioactive waste (HTRW); situations involving M W are specified as such only in very recent multi-agency regulations and guidance documents. Appendix D describes Department of the Army (DA) LLRW and MW disposal and remediation policy. Included in Appendix D are recommended forms for USACE project reports on proposed LLRW/MW generation/remediation activities, an outline for disposal plans and reports, and a request for LLRW/MW or generated for disposal.

1-5. USACE Involvement in LLRW and MW

a. Involvement. USACE was deeply involved, by way of its mission in the Manhattan Project of World War II, in the inception of nuclear engineering. Since then, commercial interests and other federal agencies, rather than USACE, have controlled and developed nuclear technology. Discovery and disposal of radioactively contaminated waste have developed into a national problem of sufficient magnitude and complexity that USACE is becoming involved again, this time in the mission of restoring LLRW and MW sites. To enhance the USACE technical capability and support USACE activities, a Center of Expertise (CX) on LLRW and M W was established at the U.S. Army Engineer Division, Missouri River, which is the current USACE CX for hazardous and toxic waste. HQUSACE has developed a unified management plan for HTRW. To support the HTRW CX and the USACE LLRW program,

IOC has signed an Interservice Support Agreement (July 199 1) to provide support services in the areas of LLRW collection, packaging, certification, handling, shipping, and disposal.

b. Anticipated origins of missions.

(1) DOE. A number of major LLRW and MW site remediation missions were requested by the DOE. This arises from the Memorandum of Understanding (MOU) between the DOE and USACE (Duffy and Page 1990) in which USACE agreed to support DOE Headquarters, Operations Offices, and subordinate installations in connection with environmental restoration and waste management. By this MOU, elements of USACE continue to be deeply involved in sites such as inactive or decommissioned research reactors, old radioactive waste storage and disposal sites. In addition to the wide range of types of sites, the potential contamination ranges from completely nonradioactive to sites inadvertently involving transuranic and high-level radiation waste.

(2) EPA. USACE and the EPA have in force an Interagency Agreement concerning execution of the CERCLA (Thomas and Dawson 1982). This agreement provides for USCE technical assistance to the EPA during remedial investigation and feasibility study phases particularly to verify reasonableness of design, construction, and operation activities. USACE may also manage design and construction and provide other technical assistance in enforcement-led projects, as well as projects that are funded by individual states or the EPA. CERCLA-mandated efforts can involve nongovernmental agency sites of LLRW and MW contamination.

(3) DERP. USACE will, as the executing agent for DA and DoD, participate as ordered in the DERP and undertake restoration of DoD LLRW- or MW-contarninated formerly used defense sites (FUDS) as well as currently active Army installations. DoD installations involving fabrication, storage, maintenance, application, and use of nuclear weapons, propulsion units, power generators, medical facilities, or other military hardware incorporating radionuclides are addressed by DERP.

1-6. General Policy Considerations

a. Pertinent regulatory agency interfaces.

(1) A historic artifact of the Nation's developed culture and regulatory environment is an effective separation of responsibility between governing agencies based on the nature of dangerous waste material. Radioactive wastes have been the concern, successively, of the Atomic Energy Commission (AEC), the Energy Research and Development Administration (ERDA), the DOE, and the NRC. The DOE was primarily concerned in the past with radioactive wastes generated from defense-related programs of the federal government. Presently, the DOE is deeply committed to high-level waste disposal as well as defense-related material. The NRC was primarily concerned with radioactive wastes arising from commercial industries involved with power generation and medicine. The NRC now must also be concerned with radioactive mining tailings as well as those materials defined in Title 10 of the Code of Federal Regulations. Nonradioactive hazardous/toxic waste (HTW) has been EPA's concern. The EPA is now working with both the NRC and the DOE in developing disposal regulations for MW. The EPA is also working with states in LLRW problem areas. Separation of regulatory responsibilities has not been constant through the evolution of those agencies. Conflicts in defined responsibilities are reflected in various regulations that are located in separate documents but address similar subjects.

(2) Additionally, other levels of government (i.e., Native American tribes, regional compacts, states, counties, and municipalities) have jurisdictions and internal regulations with varying aims and degrees of detail.

(3) USACE, in remediating LLRW sites, must coordinate with the Federal regulatory agencies whose missions include LLRW management. USACE must, in remediating MW sites, coordinate with the Federal regulatory agencies dealing with chemically hazardous materials. USACE must also deal with the other levels of government in order to accomplish its mission in remediation of LLRW- and M W-contaminated sites. Maximum reasonable effort must be devoted by USACE, its personnel, and its contractors to open communication and cooperation with the separate agencies. Conflicts between regulatory responsibilities and satisfaction of requirements of the separate agencies should be recognized by the USACE Project Manager as soon as possible and communication must be established and maintained so as to accomplish USACE missions effectively and efficiently.

b. Public information policy. The agency establishing the scope of work for a particular USACE mission has the ultimate responsibility for public relations, but USACE, under the direction of the lead agency, should endeavor to satisfy the intentions of openness beyond the mandated requirements. Hazardous, toxic, and radioactive wastes are subjects of extreme concern, in some cases fear, to the Nation's population, both general and

local. Necessary public information includes appropriate public education pertinent to the missions undertaken, establishment of formal and informal opportunities for public comment, description of the decision-making processes involved in LLRW and M W site remediation, and open disclosure of decisions and activities as they occur. Regulations exist mandating the nature and quantity of public information to be communicated on hazardous and radioactive wastes. These regulations are presented in CERCLA/SARA, RCRA, etc. At CERCLA sites, the primary reference for public involvement and response plans is EPA publication EPA/540/G-88-O02 (1988a).

c. General health and safety policy. LLRW and MW site remediation projects undertaken by USACE and its contractors shall be in full compliance with all federal and local regulations concerning the health and safety of its own onsite personnel, those persons associated with USACE at LLRW and MW remediation project sites, and the general public which may be immediately affected by the USACE work on LLRW and MW remediation sites.

d. General environmental policy. Consistent with its overall organizational concerns, USACE and its contractors shall comply with all federal, state, and local regulations and laws dealing with the preservation of environmental quality, with the mitigation of damage to the environment, and with the remediation of adverse environmental effects arising from its efforts. The subject of concern within this manual is, in itself, remedial action on sites already contaminated by LLRW and MW. The remedial action selected will be consistent with those described in AR 200-1, which include:

(1) Protection of human health and the environment.

(2) Engineering/technical feasibility.

(3) Long-term effectiveness

(4) Life-cycle cost,

(5) Public acceptability.

LLRW and MW contamination arising from past actions by others may preclude restoration to pristine environmental conditions. However, missions undertaken by USACE in this field have as one of their primary goals a reasonable and meaningful improvement in the existing environment.

e. Personnel training and certification. Specialized training courses exist for employees engaged in HTRW projects. This training is available within USACE and other governmental agencies as well as commercial and academic organizations. USACE offices dealing with LLRW and MW site remediation projects shall verify that appropriate training is accomplished by in-house and contract personnel.

1-7. Definitions

The following definitions are considered basic and most pertinent to the remainder of this EM. Additional definitions of terms and definitions of acronyms used in this EM can be found in Appendix B.

a. Activity. A measure of the rate of nuclear disintegrations occurring in a given quantity of material over a unit of time; the standard unit of activity is the Curie (Ci), which is equal to 3.7×10^{10} disintegrations per second (alps). The SL unit is the Becquerel (Bq), equal to 1 dps.

b. Agreement states. Any states with which the Nuclear Regulatory Commission has established an agreement to allow the state to regulate radioactive materials within its boundaries. Nonagreement states will abide by NRC regulations.

c. Alpha radiation. One of the particles emitted in radioactive decay consisting of two protons bound with two neutrons. Travels only a short distance in air.

d. As low as reasonably achievable (ALARA). A policy for maintaining exposures (individual and collective) as low as is reasonable, taking into account social, technical, economic, practical and public policy considerations. ALARA is not a dose limit, but a standard of excellence that has the objective of attaining doses as far below the applicable controlling limits as is reasonably achievable.

e. Background radiation. Radiation in the environment from naturally occurring radioactive isotopes, cosmic radiation, and fallout from man's activities such as nuclear weapons testing.

f. Beta radiation. One of the particles emitted during radioactive decay, consisting of an electron. Positively charged type is called a positron.

g. Bioassay. Measurement of radioactive material deposited within or excreted from the body. This process includes whole body and organ counting as well as urine, fecal, and other specimen analysis.

h. Combined or co-mingled waste. Waste that contains a radioactive component and a hazardous component, and does not meet the strict definition of a mixed waste.

i. Derived air concentration. The concentration of a radionuclide in air that, if breathed over the period of a work year, would result in the annual limit on intake (ALI) for that radionuclide being reached.

j. Dose. The amount of energy deposited in body tissue due to radiation exposure. Various technical terms, such as 'dose equivalent,' 'effective dose,' 'equivalent,' and 'collective dose,' are used to evaluate the amount of radiation an exposed worker receives.

(1) Dose equivalent, measured in units of Roentgen equivalent man (rem), is used to take into account the difference in tissue damage from different types of ionizing radiation.

Technical definitions for dose terms include the following:

(2) Absorbed dose (D). Energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The units of absorbed dose are the rad and the Gray (Gy). 1 Gray equals 100 rad.

(3) Dose equivalent (H_T): The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert (Sv). 1 Sv equals 100 rem.

(4) Effective dose equivalent (H_E). The sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma W_T H_T$).

(5) Committed dose equivalent ($H_{T,50}$). The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by a person during the 50-year period following the intake.

(6) Committed effective dose equivalent ($H_{E,50}$). The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E.50}=\Sigma w_T H_{T.50}$).

(7) Total effective dose equivalent (TEDE). The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

(8) Shallow dose equivalent. Applies to the external exposure of the skin or an extremity. It is taken as the dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm^2.

(9) Weighting factor. Factor that represents the proportion of the total stochastic (cancer plus genetic) risk resulting from irradiation to tissue to the total risk when the whole body is irradiated uniformly.

k. Exposure. A measure of the ionization produced in air by X or gamma radiation, equal to the sum of the electrical charges on all ions of one sign produced per unit mass of air. The special unit of exposure is the Roentgen, equal to 2.58×10^{-4} coulombs per kilogram.

1. Gamma radiation. Electromagnetic waves emitted from the nucleus of an atom during radioactive decay; highly penetrating, e.g., a substantial fraction penetrates several centimeters of lead.

m. High-level radioactive waste (HLRW). The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains fission products in concentrations that require permanent isolation.

n. Low-level radioactive waste (LLRW). Radioactive waste not classified as high-level waste, transuranic waste, spent nuclear fuel, or uranium and thorium mill tailings.

o. Mixed waste (MW). Waste containing both a radioactive component defined by the Atomic Energy Act (source, by-product or special nuclear material) and a hazardous component defined in the Resources Conservation and Recovery Act (listed or characteristic wastes).

p. Radioactivity. The property of certain naturally unstable isotopes of spontaneously emitting particles or electromagnetic radiation.

q. Transuranic (TRU) waste. Without regard to source or form, waste that is contaminated with

alpha-emitting transuranic radionuclides having half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay.

s. X-radiation; X-ray. Electromagnetic waves identical to gamma radiation, but originating from the orbital electrons and usually having slightly longer wavelengths.